OPERATIONS ON THE LOWER ENDS OF THE URETERS BY THE INGUINAL EXTRAPERITONEAL ROUTE UNDER LOCAL ANÆSTHESIA (COCAINE).

A REPORT OF THREE URETEROVESICAL IMPLANTATIONS AND THE REMOVAL OF A URETERAL CALCULUS.

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PATHOLOGICAL conditions of the lower end of the ureter usually impair its function, either by interfering with the passage of urine from the kidney to the bladder or else permitting a reflux of urine from the bladder into the kidney. In either instance there is a damming back of urine into the pelvis of the kidney with a consequent hydronephrosis. If the ureter is thickened and inflamed, its lumen may not become greatly enlarged, because the pressure is not sufficient to stretch its thickened walls, as may be frequently seen in a tuberculous ureter, and also if the ureter is embedded in dense tissue its expansion will be interfered with. On the other hand, a stricture (from any source) of the lower end of the ureter usually causes a hydroureter, which may become tortuous, and the natural dilatations of the ureter may become greatly enlarged as contrasted with the natural constrictions which may be little or not at all affected by the distention of the ureter. The distention and tortuosity of the ureter may cause it to break through the tissue about it, *i.e.*, its imperfectly formed sheath,[1] thus giving rise to hernial formations, the ring of the hernia being formed by the intact sheath at either end of the point of rupture. These hernial rings of the ureteral sheath may cause the so-called valves sometimes found in these cases. The function of the kidney whose ureter is diseased is not only interfered with, but

the organ is in a condition of lowered local resistance, and sooner or later the kidney is apt to become infected either through organisms carried there by the circulating blood or from others which may gain access to the lumen of the ureter and reach the kidney through the damming back of urine caused by the ureteral stricture.

We may speak of the condition brought about by a diseased ureter as that of renal insufficiency. This insufficiency may be *relative*, which is especially true if only one ureter is diseased and the other being intact is sufficient; or even if both are involved, the two kidneys together may be able to maintain renal function sufficient for the individual. In this condition there is renal sufficiency, and the term *relative renal insufficiency* is used only in a comparative sense. In other cases where both ureters are involved and *renal compensation* or *recuperation* has not taken place, there exists a condition of *renal insufficiency* which may be temporary or permanent. The compensatory ability of the kidney is a very interesting condition, and we are all familiar with the hypertrophied kidney resulting from compensatory changes which have taken place in one kidney after the other has been removed or its function has been impaired. Of still greater interest is the recuperative power of the kidney. Temporary obstructive anuria may occur and yet the individual may live, and especially interesting are those cases in which both ureters have been accidentally ligated for from twenty-four to seventy-two hours, and where, after the ligatures have been released or the ureters have been reimplanted into the bladder, the kidneys have resumed their function and the individual has recovered, as have been reported by Zweifel,[2] Purcell,[3] Markoe and Wood,[4] Neumann,[5] Bailey,[6] and I have seen one such case. It is evident, then, that the kidney has great recuperative ability, and this knowledge should influence the surgeon in the operative treatment of such conditions. I am conducting a series of experiments along these lines, and one dog lived and was well five months after the removal of its normal kidney, there being apparently perfect renal sufficiency from a kidney whose ureter had been

ligated for one week, and then the distended ureter was resected and reimplanted in the bladder; and after waiting one month for its kidney to recuperate, the hypertrophied sound kidney was removed. Experiments along these lines and also clinical experience teach us that the kidney has great recuperative ability, and that operations on the kidney should be more conservative.

We must consider two general classes of diseased conditions of the lower ends of the ureters:

I. Those cases with absolute renal insufficiency demanding an immediate operation, in which nephrotomy plays such a prominent rôle, in order to relieve a kidney with or without infection, whose ureter has become partially or completely occluded. (I have purposely omitted the postoperative anuria due to occlusion of the ureters by ligatures when the operation of choice should be the release of the ureter.) In this first class of cases, the operative treatment is temporarily to relieve the condition, and nephrotomy seems to be the operation of choice in most of these cases. It may be done under nitrous oxide anæsthesia, as recommended by Bevan,[7] and as has been done in this hospital; or, as the operation is of short duration, it may usually be done under ether or chloroform. Two of the three cases reported in this article had bilateral nephrotomies in order to relieve the renal insufficiency existing at the time.

II. The second class of cases are those of relative renal insufficiency, in which the cause of the trouble still exists, and a temporary relief by a nephrotomy may or may not have been done. In order to cure the patient, the cause of the trouble must be removed, the ureter resected and reimplanted in the bladder, or a stone removed which may be obstructing the lumen of the ureter, or some other operation done to relieve the local condition. These operations usually take a long time and require exacting, careful work, in a patient with an unstable renal sufficiency, and on this account sometimes ill suited to undergo a prolonged general anæsthesia.

If certain operations may be done well without causing the patient much discomfort or pain, a local or general anæsthetic

may be dispensed with for these operations. This proposition may be carried still further; if in a long operation certain steps are painful and others are not, why should we not use a temporary anæsthetic, such as nitrous oxide, or a local anæsthetic, as cocaine, for those steps of the operation which cause pain, and *omit* an anæsthetic when it is not necessary? It becomes very evident that a knowledge of the sensibility of the field of operation to pain should influence the surgeon in choosing an anæsthetic, especially if a general anæsthetic is contraindicated.

In all three cases, with four operations under local anæsthesia, about to be reported, the condition was that of relative renal insufficiency due to a diseased condition of the lower ends of the ureters.

In the first case the condition was that of bilateral ureteral stricture with ureteral inefficiency, *i.e.*, the diseased lower ends of both ureters had been converted into sinuses, which interfered with the passage of urine from the kidneys to the bladder and were also unable to prevent a reflux of urine from the bladder into the kidneys.

In the second case, the lower ends of both ureters had been dissected free in a more radical operation for carcinoma cervicis uteri with a resulting unilateral ureteral necrosis, giving rise to a ureteral fistula. As the lower ends of both ureters had been freed, the function of both may have been interfered with, at least temporarily. The necrosis of one ureter gave rise to a ureteral fistula with consequent formation of a ureteral stricture, and thus impairment of the function of the kidney.

In the third case there was bilateral renal infection associated with a cystitis. Double nephrotomy had temporarily relieved the condition. A calculus which partially occluded the right ureter was diagnosed by means of the wax-coated catheter and X-rays.

CASE I.—Mrs. T. M., aged thirty-two years. Gyn. Nos. 9495, 9705, and 11,101½. (Referred to in a previous communication.[8])

Diagnosis.—Double pyonephrosis with double ureteritis, stricture and inefficiency of the vesical ends of both ureters per-

mitting a reflux of urine from the bladder into the pelvis of the kidneys.

Operation.—Resection and implantation of both ureters into the bladder, by the inguinal extraperitoneal route. September 8, 1903, and November 11, 1903.

Anæsthetic.—Cocaine (Schleich's Solution). Contraindications to a general anæsthetic. Renal insufficiency. Patient had been given a general anæsthetic on previous occasions, and after the last operation she not only left the table in bad condition, but the convalescence was very slow, being marked by prolonged nausea, vomiting, and a rapid pulse.

HISTORY OF CASE.—*Family History.*—Negative; no history of tuberculosis.

Personal History.—Negative; always well until present illness. Married seven years; two para (five and two and a half years), one miscarriage before the birth of her first child. Labors normal; no history of puerperal fever.

Present Illness.—Began before the birth of her first child five years ago, with frequent micturition, without pain or hæmaturia. Following the birth of the child she had hæmaturia, with pain and burning on voiding. Ever since the onset of her illness, over five years ago, the patient has been troubled with her bladder, the difficulty being at times slight, interfering with her work but little; and at other times severe, forcing her to go to bed. Recently, the trouble has been getting worse, her urine has been purulent, at times ammoniacal, and her general health has been poor.

Patient was first admitted to this hospital in March, 1902. A diagnosis of double pyonephrosis was made. Tubercle bacilli were never found in the urine; the patient was given tuberculin, but no reaction followed. Cultures taken from each kidney showed colon bacilli. At this time both ureters could be distinctly palpated and were thickened and tender. The ureteral orifices appeared like two large funnels. The patient was treated by rest and frequent irrigations of the pelves of both kidneys through renal catheters. She left the hospital, June 3, 1902, improved, and was readmitted one week later, and remained in the hospital one month, during which time the pelves of both kidneys were irrigated three times a week with a solution of silver nitrate, 1 to 500, followed by sterile water.

After leaving the hospital the patient remained home for

three months, and was readmitted October 5, 1903. Apparently the treatment in the hospital had given her temporary relief only. The kidneys were irrigated, as on previous admission, until December 22, 1902, when an incision was made into the left kidney by Dr. Kelly, and a vesicovaginal fistula was also formed. This was done because the bladder had become markedly inflamed and it was impossible to catheterize the ureters. A month later the vesicovaginal opening was enlarged and a suprapubic incision was made in order to give the bladder freer drainage. At the end of six months the patient's condition had improved but very little. There was evidently a stricture of both ureters, for the left could be catheterized only with great difficulty and the right not at all. Cultures from the left kidney showed a pure culture of B. pyocyaneus instead of the B. coli communis as at the previous admission. The patient desired to go home, but before closing the vesicovaginal fistula in order that she might go, I determined to ascertain whether or not it would be safe to do so.

On June 7,, 1903, a catheter, which was connected with a funnel by rubber tubing, was inserted into the bladder, and the vesicovaginal opening was closed by a finger inserted into the vagina. Fluid was now poured into the funnel, and thus the bladder was filled until the distention caused discomfort but no actual pain. The patient stated that she could feel something passing up her ureters into her kidneys, which caused pain in both kidneys. The fluid was withdrawn from the bladder. Three hours later the patient's temperature rose to 102.6° F. She had a chill and severe pain in the region of both kidneys. The elevation of temperature and pain lasted four days, and gradually subsided. It was evident that the distention of the bladder caused a reflux of the bladder contents into the ureters, thus interfering with the function of the diseased kidneys and causing a reinfection of the kidneys, with the clinical symptoms of pain and fever. A closure of the vesicovaginal fistula would give rise to the same condition, for the diseased vesical portions of the ureters were rigid tubes, and were unable to prevent a reflux of urine when the bladder was distended.

June 26, 1903, the right kidney was incised by the author making a nephrostomy.

July 20, 1903, I resected the lower end of the left ureter and reimplanted it into the bladder by the extraperitoneal route

under general anæsthesia. (Chart I.) Following the operation, the patient was very ill, with nausea and vomiting which lasted irregularly over a period of nearly two weeks, and a rapid, weak pulse. Patient recovered; ureteral orifice easily catheterized. Operation apparently successful, but later proved not to be. (See notes following the next operation.)

Because the patient had been so ill after the last operation and also after other operations referred to in this article, I decided to resect and reimplant the right ureteral orifice under local anæsthesia.

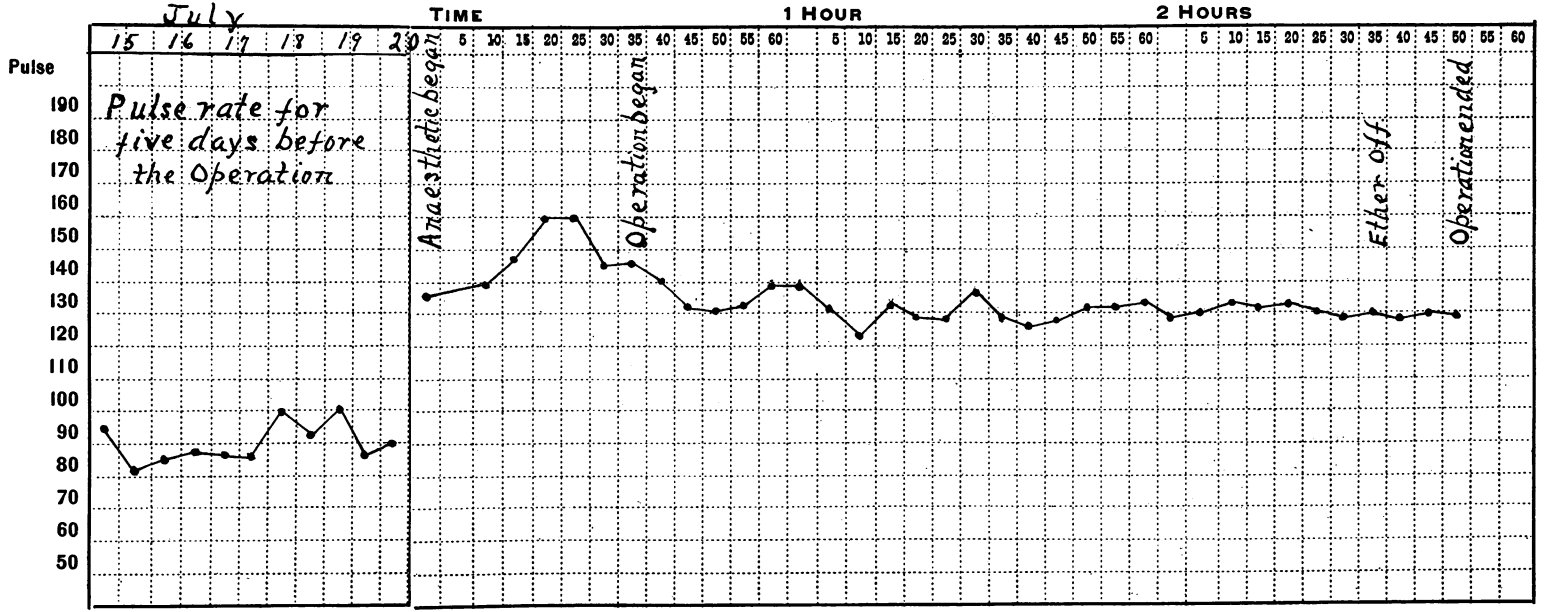
Resection of the Right Ureter and its Implantation into the Bladder by the Inguinal Extraperitoneal Route, through a low McBurney Incision, for Inefficiency of the Ureteral Orifice. September 8, 1903. Duration of operation, five hours and fifteen minutes. Anæsthetic, Cocaine (Schleich's Solution), where necessary.

An incision was made through the skin, infiltrated with Schleich's Solution, from a point three centimetres mesial and above the anterior superior iliac spine and extending down to the insertion of the rectus muscle in the pubic bone. The aponeurosis of the external oblique muscle was split open and the deeper muscles were exposed, and the fibres separated by blunt dissection, thus giving rise to a "gridiron incision" similar to McBurney's incision, and exposing the peritoneum. The deep epigastric vessels and the round ligament were cocainized, clamped, cut, and ligated.

The peritoneum was now dissected free from the abdominal wall and side of the pelvis, and the external iliac vessels were exposed and the *hypogastric artery. The latter served as a useful guide to the uterine artery and the ureter.* The ureter was found to be much thickened, about one and a half centimetres in diameter, and adherent to the surrounding tissues. The lower pelvic portion of the ureter was dissected free, it being necessary to clamp, cut, and ligate the uterine artery in order to accomplish this. The ureter was freed down to the bladder, where it was cocainized and cut across. A sound was introduced into the bladder through the urethra and the bladder wall was pushed out and opened near the end of the ureter. The end of the ureter was split into two flaps, and a catgut suture was passed through the end of the ureter and into the opening in the bladder and out of

CHART I.

Name.—Mrs. T. M. **Age, 32.** Gyn., Nos. 9495, 9705, and 11,101½.
Date.—July 20, 1903.
Diagnosis.—Inefficient ureteral orifices, permitting a reflux of urine from the bladder into the kidneys.
Operation.—Resection of the ureter (left) and its implantation into the bladder by the inguinal extraperitoneal route.
Anæsthetic.—Nitrous oxide and ether.
Amount of Anæsthetic.—Nitrous oxide to start, ether about 340 grammes.



Anæsthetic well taken; pulse rather weak throughout the operation. Convalescence marked by nausea and vomiting, lasting irregularly for nearly two weeks after the operation; pulse rapid, poor quality; patient very ill. Notice the even pulse-rate after patient is completely under anæsthetic. Compare with Chart III. Result, patient recovered; the ureterovesical implantation healed, but the ureteral orifice was still inefficient, permitting a reflux of urine from the bladder into the ureter.

Chart II.

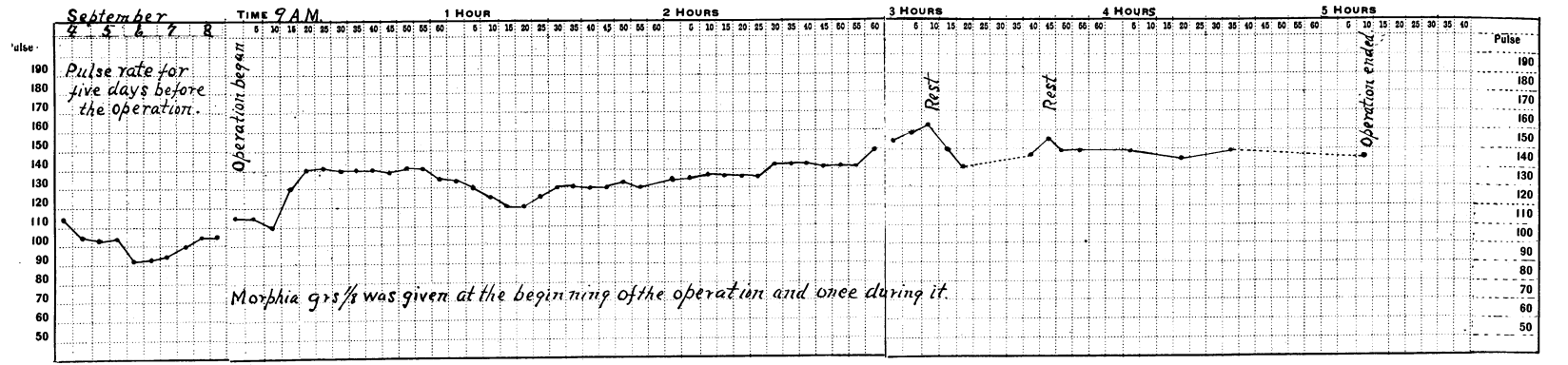
Name.—Same patient as Chart I.

Date.—September 9, 1903.

Diagnosis.—Inefficient ureteral orifices, permitting a reflux of urine from the bladder into the kidneys.

Operation.—Resection of the right ureter and its implantation into the bladder by the inguinal extraperitoneal route, through a modified McBurney incision down to the peritoneum.

Anæsthetic.—Cocaine (Schleich's Solution) for the abdominal incision down to the peritoneum, and then where necessary.



Traction on the parietal peritoneum was the main source of pain during the operation. In order to expose the field of operation, it was necessary to push aside the freed peritoneum; this caused pain; any change in position must be gradual and done carefully in order to avoid unnecessary pain. The effect of the operation was that of hard work, the patient felt "tired out." Had more frequent "rests" been made, the "work" would have been easier and the pulse would not have maintained such an even high rate, but would have been irregular. See Charts III, V, and VI. Result, operation was successful, the ureteral stricture was cured, and the ureteral orifice became efficient, a reflux of urine being impossible.

the urethra, and the ureter was thus drawn into the bladder, so that it protruded over one centimetre into the cavity of the bladder and remained there, while the ureter was sutured in place with fine silk, taking care to suture the bladder wall *to the ureter* and *not* around it, so as to avoid a stricture.

A piece of rubber tubing was placed transversely across the vaginal orifice, and the catgut suture which had been passed through the end of the ureter and out through the urethra was tied around it in order to relieve the tension on the sutures fastening the ureter into the bladder. Gauze drains were placed down to the seat of the operation and the incision was partially closed.

Any procedure which made traction on the parietal peritoneum caused pain, as the separation of the peritoneum from the sides of the pelvis, traction on the ureter and freeing it, while pinching the ureter caused little or no pain. The uterine artery was clamped, cut, and ligated without causing pain. Pushing out the greatly thickened bladder with the sound introduced through the urethra and making the incision into its walls caused pain, while the actual suturing of the bladder to the ureter did not seem to cause pain. As the exposure of the field of operation required pressure on the parietal peritoneum, which had been freed from the abdominal and pelvic walls, this had to be done very carefully, and any change in position must be made gradually in order not to cause any unnecessary pain. The most painful part of the operation was suturing the abdominal incision at the close of the operation. The patient stood the operation very well. The pulse was rapid during the operation, at one time reaching as high as 160. The maintained high pulse-rate was due to the absence of frequent rests. Had there been more rests, the pulse curve would have been irregular, as in Chart III of the same case, where rests of from two to five minutes were very frequent; also the operation would have been much easier for all concerned.

The effect of the operation was that of hard muscular exercise, and the patient felt tired out. The general condition of the patient, aside from the fatigue, was the same after as before the operation. The convalescence was as rapid as might be expected in one recovering from the effect of several hours' hard work or from a long time spent in a dentist's chair. *The operation was a success.* The implantation healed, and it was impossible to force fluid from the bladder into the right kidney, as shown by

the following. On November 11, 1903, the bladder was distended with a solution of methylene blue, and the patient stated that she could feel the fluid pass up the left but not up the right ureter. The bladder was now washed out with sterile water, and on making a cystoscopic examination the blue fluid could be seen coming out of the left but not from the right ureteral orifice. The ureters were catheterized, and the blue fluid was obtained from the pelvis of the left kidney but not from the right, thus demonstrating that the left ureteral orifice was still inefficient and permitted a reflux from the bladder, while the right ureteral orifice was functionally normal. The right ureter, having a diameter of fully one centimetre, projected into the cavity of the bladder for a distance of nearly one centimetre, while the orifice of the left one formed a funnel-shaped depression in the bladder. It was decided to again resect the left ureter and to try to imitate the condition present in the right.

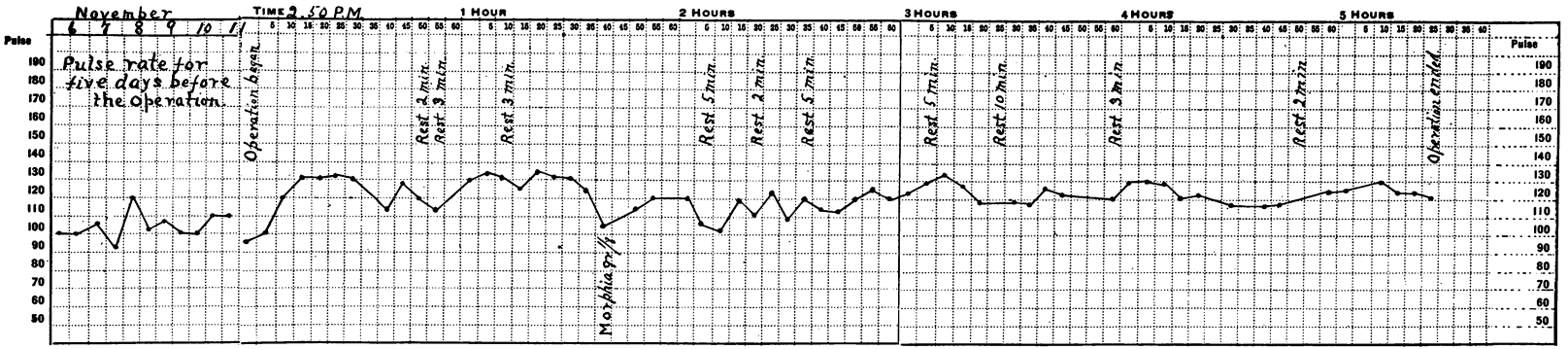
Resection of the Left Ureter and Its Reimplantation into the Bladder by the Inguinal Extraperitoneal Route, for Inefficiency of the Ureteral Orifice. November 11, 1903. Duration of the Operation, Five Hours and Twenty-five Minutes. Anæsthetic, Cocaine (Schleich's Solution), where necessary.

The ureter had been resected and reimplanted into the bladder, July 20, 1903 (under ether), for an inefficient ureteral orifice, and the operation had failed, for when the bladder was distended with fluid the fluid passed up into the pelvis of the kidney. On the other hand, the reimplantation of the right ureter (under local anæsthesia), *leaving* a *long piece* of the *ureter projecting* into the *bladder*, was *successful*, and fluid could not be forced from the bladder into the pelvis of the kidney.

An attempt was made to imitate the implantation of the right ureter. The scar tissue caused by the previous operation, July 20, 1903, rendered the operation very difficult. The operation was done as the one described September 8, 1903, except that the ureter was higher up in the pelvis, and on that account was more accessible; but the adhesions from the previous operation made its exposure more difficult. As in the previous operation, any steps in the operation which made traction on the parietal peritoneum caused pain. On the other hand, handling and cutting the ureter, as well as suturing the ureter into the bladder, did not seem to cause pain, while making an opening into the bladder seemed

Chart III.

Name.—Same patient as Charts I and II.
Date.—November 11, 1903.
Diagnosis.—Inefficient ureteral orifice (left), permitting a reflux of urine from the bladder into the kidney.
Operation.—Resection of the ureter and its implantation into the bladder by the inguinal extraperitoneal route.
Anæsthetic.—Cocaine (Schleich's Solution) for the abdominal incision down to the peritoneum, rest of the operation was done, for the most part, without an anæsthetic.



Traction on the parietal peritoneum was the main source of pain during the operation. Pinching, cutting, and suturing the ureter were apparently painless. The bladder (thickened and inflamed) was apparently very sensitive. Suturing the abdominal incision was the most painful part of the operation. Patient stood the operation remarkably well. The effect of the operation was that of hard work, the patient felt "tired out." Frequent "rests" caused a temporary fall in pulse-rate, giving rise to the irregular chart. Compare with Chart II. The general condition of the patient, aside from the fatigue, was the same after as before the operation. Result, the ureterovesical implantation healed, but the ureteral orifice was still inefficient. A similar operation on the right ureter was successful. Chart II.

to be painful. This operation differed from the one in the opposite side in that a small rubber male catheter about three millimetres in diameter was inserted into the ureter and out through the bladder and urethra and removed on the second day.

As in the previous operation, the patient felt tired out; the convalescence was rapid, as one recovering from the effect of several hours' hard work. On comparing the pulse Chart III with the chart of the operation on the other ureter (Chart II), it will be noticed that in Chart III the pulse varied much in rate during the operation. This variation in rate was apparently due to the frequent rests. While operating, the hard work on the part of the patient causes an increase in the pulse-rate, which is lowered by a two to eight minutes' rest, again to increase in rate when the operation begins. Frequent rests with a chance to change the position of the patient make the operation easier for all concerned. The ureterovesical implantation held, but the tip of the ureter projecting into the bladder sloughed off, leaving a ureteral orifice which was inefficient, as it had been after the previous operation.

An attempt was made to dilate the bladder slowly and carefully, and so possibly compress the ureteral orifice and render it efficient, but this failed. The vesicovaginal fistula was closed and the old trouble returned, but it was unilateral instead of bilateral, for the right ureteral orifice was able to prevent the reflux from the bladder. It was finally necessary to reopen the bladder and discharge the patient with a vesicovaginal fistula, which relieves all intravesical tension; and, under the circumstances, the patient will probably have to always have a vesicovaginal fistula.

Before beginning these operations, the patient had cystitis with bilateral renal infection, bilateral ureteritis, and stricture and inefficiency of both ureteral orifices. As a result of the operations, the cystitis disappeared and the stricture of the ureteral orifices was cured, and thus the condition of both kidneys was much improved; and one ureteral orifice is efficient, while the other, after two ureterovesical implantations, is unable to prevent a reflux of urine from the bladder if the bladder is closed. So it is necessary to have a vesicovaginal fistula in order to relieve intravesical tension, or else remove the left

kidney, which does not seem desirable, for fear of renal insufficiency of the opposite organ. A left nephrostomy could be done, but it would be difficult to maintain with a patulous ureter, and, besides, it has not many advantages over a vesico-vaginal fistula.

CASE II.—Mrs. A. M., aged forty-eight years. Gyn. Nos. 10,622, 10,713. (Referred to in a previous communication.[9])

Diagnosis.—Left ureterovaginal fistula, from necrosis of the ureter following hysterectomy for carcinoma cervicis uteri.

Operation.—Ureterovesical implantation, extraperitoneal, September 16, 1903.

Anæsthetic.—Cocaine (Schleich's Solution).

Contraindications to a General Anæsthetic.—Both ureters had been freed in the previous operation, leading to necrosis of the left ureter and the formation of a ureterovaginal fistula. The liability of renal insufficiency had to be considered, due to the interference with the function of the ureters. In addition, the patient dreaded a general anæsthetic.

HISTORY OF CASE.—*Family History* was negative; no history of cancer.

Personal History.—Always well. Married. Eight children.

Present Illness.—Patient was admitted to the hospital, July 21, 1903, with a diagnosis of carcinoma cervicis uteri with symptoms of bleeding for eighteen months.

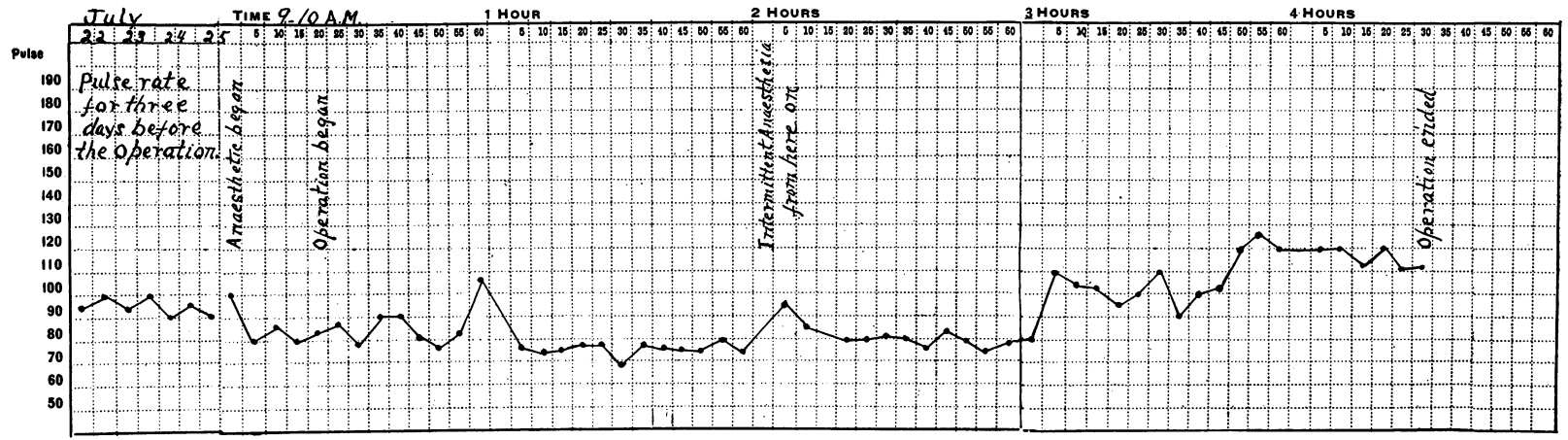
July 25, 1903, a more radical operation was done by the author. The ureters were dissected free, and an attempt was made to remove all the tissue from pelvic wall to pelvic wall. (Chart IV.) A lymph-node removed from the bifurcation of the left iliac artery proved to be cancerous. A left ureterovaginal fistula resulted, the escape of urine appearing on the thirteenth day.

The patient left the hospital August 27, 1903, with a ureterovaginal fistula, and returned October 10, 1903, desiring to have it closed.

DESCRIPTION OF OPERATION FOR THE CURE OF THE URETEROVAGINAL FISTULA.—Duration of operation, six hours and ten minutes. A skin incision was made under Schleich's Solution, parallel to Poupart's ligament, beginning about three centimetres mesial to the anterior superior iliac spine and extending down to the inser

CHART IV.

Name.—Mrs. A. M. Age, 48. Gyn., No. 10,622.
Date.—July 25, 1903.
Diagnosis.—Carcinoma cervicis uteri.
Operation.—Abdominal hysterectomy, with removal of the pelvic lymphatics and freeing the ureters.
Anæsthetic.—Ether.
Amount of Anæsthetic.—About 500 grammes.



Anæsthetic well taken, the last hour the pulse was weaker and more rapid. Compare with Chart V. Convalescence, aside from the formation of a ureterovaginal fistula due to necrosis of the ureter, was uneventful. Discomfort, with nausea and vomiting, which may follow a long operation under a general anæsthetic. Result, recovery; ureterovaginal fistula closed September 15, 1903, under local anæsthesia. See Chart V.

CHART V.

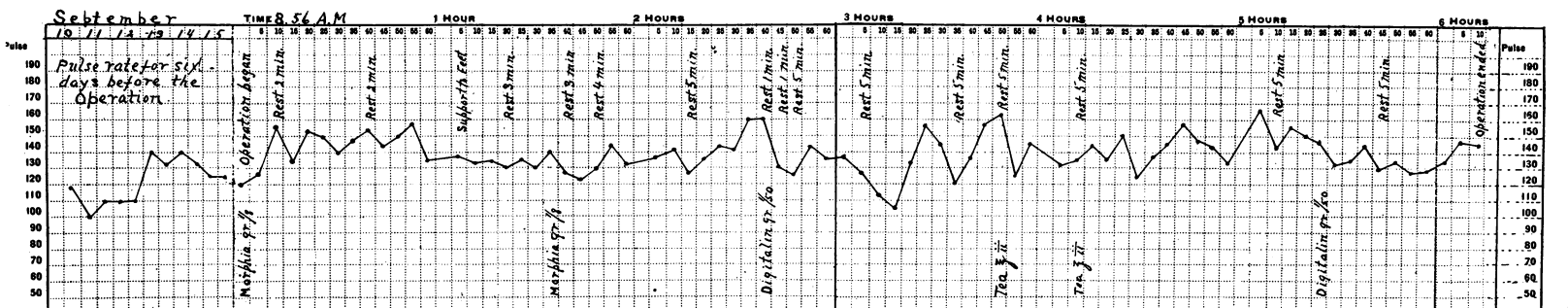
Name.—Mrs. A. M. Age, 48. Gyn., Nos. 10,622 and 10,713. (Same patient as Chart IV.)

Date.—September 16, 1903.

Diagnosis.—Ureterovaginal fistula, left, following ureteral necrosis from freeing the ureters in a more radical operation for carcinoma cervicis uteri. See Chart IV.

Operation.—Resection of the left ureter and its implantation into the bladder by the inguinal extraperitoneal route.

Anæsthetic.—Cocaine (Schleich's Solution) for the abdominal incision down to the peritoneum, and then where necessary.



As in previous operations, traction on the parietal peritoneum was the main source of pain. Both the ureter (after freeing it) and the bladder were apparently insensible to operative manipulation. The value of frequent "rests" causing a temporary fall in the pulse-rate was well brought out in this operation. The effect of the operation was that of hard work, *i.e.*, physical and nervous strain, causing a rapid pulse (temporary) and fatigue, as that of a patient in a dentist's chair. Compare with Chart IV. Result, patient cured, ureteral orifice apparently normal, unable to catheterize it, patient felt perfectly well.

tion of the rectus muscle. A similar incision was used through the muscles of the abdominal wall down to the peritoneum. The peritoneum was dissected free from the abdominal wall, and this was found to be very difficult, because it had been freed at the previous operation, the Poten incision having been used. The deep epigastric vessels were cocainized, clamped, cut, and ligated. The separation of peritoneum was carried on down to the external iliac vessels, and the bladder was separated from the sides of the pelvis. The separation of the bladder from the walls of the pelvis did not cause any pain; on the other hand, freeing the peritoneum was painful, requiring very slow and careful work. At the previous operation the round ligament and ovarian vessels had been sutured to the top of the vagina, and, in order to reach the ureter, it was necessary to cut through these structures. The ureter was found to be firmly embedded in adhesions, and with great difficulty it was dissected free down to a point about two centimetres above the bladder, where it became much smaller, being about 1.5 centimetres in diameter above this place, and filled with clear urine (cultures taken from this urine showed it to be sterile). The ureter was now cut off just above its strictured portion. Clamping and cutting the ureter (not cocainized) did not cause any pain. The ureter was dissected free for its entire pelvic portion, so that it could be brought down to meet the bladder. After the distended ureter had emptied itself, much to my surprise, it resumed its normal appearance and size. A straight aneurism needle was now introduced into the urethra and the bladder wall was pushed out in the direction of the ureter and incised. This step in the operation did not cause pain. A catgut suture was passed through the end of the ureter and tied to the end of the aneurism needle. On withdrawing the latter from the bladder through the urethra, the ureter was drawn into the bladder incision. The edges of the incision in the bladder were sutured to the ureteral wall by means of fine silk, using five or six sutures, which included the muscular coats of the ureter and bladder. The bladder wall at the site of the implantation was sutured to the side of the pelvis in order to fix the bladder at this place and relieve the tension of the implantation. Additional sutures were also taken, drawing the bladder up and fastening it to the psoas muscle. In spite of these sutures, the ureter was sutured into the bladder under considerable tension.

Gauze drains were placed down to the site of the implantation, and an additional pack was placed on top of the bladder so as to hold the bladder down on the ureter.

The observations in regard to the sensation of pain seemed to be very trustworthy in this case. The abdominal incision down to the peritoneum was accomplished under cocaine (Schleich's Solution) infiltration, with very little pain. The only feature in the operation which seemed to cause pain was traction on the parietal peritoneum. All operative steps on the ureter, such as clamping, cutting, and suturing, were without pain; on the other hand, traction on the ureter and freeing it from its peritoneal attachments (*i.e.*, traction on the parietal peritoneum) caused pain. All operative manipulations of the bladder, such as freeing it from the side of the pelvis, incising it and suturing it to the ureter and to the side of the pelvis at the site of the implantation, were apparently painless. In order to expose the field of operation, it was necessary to hold aside the freed peritoneum. This caused pain unless done very carefully, and any change in the exposure had to be done slowly and gradually in order to avoid unnecessary pain. The effect of the operation was that of hard work, manifesting itself in the fatigue after the operation and the rapid pulse during it. Had the operation been done without any rest, then undoubtedly there would have been maintained a high pulse-rate, as during prolonged exertion, somewhat as shown in Chart II; but with the frequent rests (the shorter ones not being charted) the rapid pulse manifested itself only when the operation was in progress and would fall as soon as the active operation ceased. (Chart V.) Morphia was tried, but did not seem to have much effect. Digitalin was also given to see if it would affect the pulse-rate, but it is questionable just what effect it had, for the apparent effect might have been due to the rest taken at that time. The patient felt as well after the operation as before, except for the fatigue. Apparently the patient and the operator were both fatigued as the result of the operation. What effect does pain have on the pulse? Lennander [10] speaks of the injurious effects of pain on a weak heart. A dentist thinks little of inflicting pain upon a patient for hours; and it seems to me that his operations are apparently as severe and frequently more severe than the one I have just described. The patient exercises her muscles in the following ways: The position, no matter how

comfortable, becomes tiresome (the patient frequently changes her position); to exercise self-control is hard work; besides, she does actual muscular work in grasping something with her hands or bracing her feet against some support. These procedures help the patient.

After the operation the patient was asked how she felt, and replied that, aside from feeling tired, she felt well and was hungry. She asked for bread and butter and raw tomatoes for supper, which she ate with great relish and without any apparent evil effects.

Result.—The ureterovaginal fistula was cured. There was no leakage of urine until the eighth day, when only about half the amount of urine was obtained from the bladder as on previous days, and there was an escape of a large quantity from the inguinal incision. This ceased in a few days, and the patient left the hospital cured. The bladder was examined before the patient left the hospital, and, while the end of the ureter could be seen protruding into the bladder, I was unable to catheterize it, and think that the ureter may have sloughed above the bladder, leading to a secondary fistula, which healed, but possibly with occlusion of the ureter, for the amount of urine obtained from the bladder each day did not reach the daily amount excreted during the first week after the operation.

CASE III.—Miss F. P., aged nineteen years. Gyn. No. 10,701½.

Diagnosis.—Ureteral calculus, right (situated just above the bladder).

Operation.—Ureterotomy, with removal of calculus through the inguinal extraperitoneal route, December 2, 1903.

Anæsthetic.—Cocaine (Schleich's Solution).

Contraindications to a General Anæsthetic.—Patient had obstructive anuria twice, and each time was relieved by nephrostomy; in addition, a vesicovaginal and suprapubic fistula had been formed to relieve a very severe cystitis. She had taken a general anæsthetic badly, and had been very ill afterwards, and on account of the above she desired to have this operation undertaken with a local anæsthetic.

HISTORY OF THE CASE.—*Family History* was negative; no history of tuberculosis.

Personal History.—Negative, until present illness.

Present Illness.—Six years' duration, with symptoms of a very severe cystitis,—frequency and painful micturition, urine at times bloody, incontinence of urine at night. No definite renal symptoms.

Patient admitted to this hospital, January 22, 1903. A diagnosis of cystitis was made. A vesicovaginal fistula was made February 4, 1903, by Dr. Kelly, and a suprapubic vesical fistula, March 4, 1903, by Dr. Schenck. Treatment consisted in bladder irrigations with a retention catheter, and the patient was placed in a tub of water. Patient had several attacks of fever with severe headache, without any definite localizing symptoms.

May 4, 1903. Anuria of six hours' duration. Localizing symptoms were rather indefinite, but on deep palpation there seemed to be a slight amount of tenderness under the right costal margin. A lumbar nephrotomy was done by the author, on the right side, the kidney was found to be enlarged, a large quantity of foul-smelling, purulent urine, with a small stone, escaped on opening the pelvis of the kidney. The operation was done under ether as a general anæsthetic.

July 3, 1903. Following the previous operation, the patient frequently had fever, with headache, nausea, and vomiting. During twenty-four hours previous to present operation there had been some slight pain and tenderness in the region of the left kidney, associated with the absence of urine in the bladder for eighteen hours. Nephrotomy wound on the right side was still discharging. Under ether anæsthesia, a nephrotomy was done on the left side, permitting an escape of a large quantity of purulent urine.

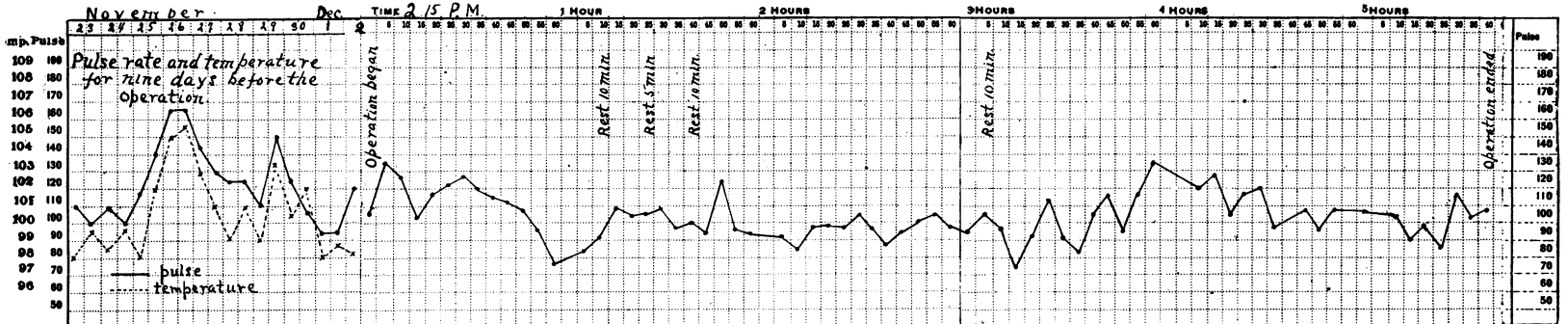
During the next month the lumbar incision in the right side would close, and associated with it there would be fever, but very few localizing symptoms. A ureteral *catheter* was *coated* with *wax* for its *entire length*, and on catheterizing the right ureter it was found to be scratched for a distance corresponding to a point just above the bladder. An X-ray was taken, and the shadow of a stone about as large as an orange-seed was seen just above the entrance of the ureter into the bladder.

DESCRIPTION OF OPERATION FOR THE REMOVAL OF THE URETERAL CALCULUS, DECEMBER 2, 1903.

Duration of operation was five hours and forty minutes. A skin incision was made under Schleich's Solution, beginning just

Chart VI.

Name.—Miss F. P. Age, 19. Gyn., No. 10,701½.
Date.—December 2, 1903.
Diagnosis.—Ureteral calculus, right.
Operation.—Ureterotomy, with removal of calculus by the inguinal extraperitoneal route.
Anæsthetic.—Cocaine (Schleich's Solution), where necessary.



Traction on the parietal peritoneum was the main source of pain. Pinching, cutting, and suturing the *freed* ureter were apparently painless. Frequent rests helped greatly, and many short ones were resorted to which were not charted. The pulse-rate increases during the operation (work) and falls during "rest." The effect of the operation was that of hard work, *i.e.*, physical and nervous strain, as that of a patient in a dentist's chair. Result, operation was successful; patient left the hospital apparently cured.

above and about three centimetres inside of the anterior superior iliac spine and carried down parallel to Poupart's ligament to the insertion of the rectus muscle. The muscles were cut through down to the peritoneum, taking care to infiltrate the blood-vessels with cocaine before clamping and cutting them. The peritoneum was pushed back from the abdominal wall. This caused pain, but by going slowly the patient was able to stand it. The round ligament and deep epigastric vessels were cocainized, clamped, cut and ligated. Both structures were apparently sensitive to pain. The freeing of the peritoneum from the sides of the pelvis also caused pain, but was accomplished by going slowly and infiltrating the subperitoneal tissue with Schleich's Solution. This latter procedure seemed to help but very little.

The ureter was exposed at the pelvic brim. *Traction on the ureter caused pain;* on the other hand, pinching the ureter with *mouse-tooth forceps did not cause pain.* The ureter was incised without causing pain. A wax-coated catheter was passed up into the kidney. No evidence of scratch-marks. The catheter was next passed down towards the bladder, and on removing the catheter it was found to be scratched to a point within six centimetres of the opening in the ureter. The ureter was now exposed down to a point within 2.5 centimetres of the bladder. A second incision was now made into the ureter at this point without causing any pain, and the stone easily felt with a probe about two centimetres below the opening in the ureter. Attempts to dislodge the stone were unsuccessful, and it was found necessary to incise the ureter over the stone, which seemed to cause a slight amount of pain, and remove it through this incision. The incisions in the ureter were closed with fine silk without causing the patient any pain. The bladder was partially freed, with but very little pain. The uterine artery was clamped, cut, and ligated without causing pain. The superior vesical artery was also cut, and some difficulty experienced in controlling it, thus emphasizing one of the disadvantages of operating under a local anæsthetic. The field of the operation was freely drained with gauze, and the skin and muscle incision partially closed with interrupted sutures of silkworm gut. The closure of the skin incision was the most painful part of the operation.

As in the previous operations under a local anæsthetic, the main source of pain came from traction on the parietal peritoneum,

either in freeing it, maintaining an exposure by drawing it aside, or dissecting the ureter from it. The patient stood the operation very well, and the effect of the operation was that of fatigue. The patient felt tired out. The patient stated that she preferred an operation under cocaine to one under a general anæsthetic.

Result.—Patient recovered.

The vesicovaginal fistula was successfully closed, March 5, 1904, under ether. The patient desired to have it done under cocaine, but the exposure was very difficult, and the general anæsthetic permitted greater relaxation, and hence a better exposure; and there were not the same contraindications as at the previous operation, for the removal of the calculus permitted the kidney to recuperate, and the general condition of the patient was much better, and, besides, the operation was of short duration. May 14, 1904, the suprapubic vesical fistula was also successfully closed under ether. A previous attempt to close it under cocaine was unsatisfactory and failed. This attempt was much more painful than any part of the operation when the calculus was removed, the scar tissue about the fistula being very sensitive and difficult to excise. Patient discharged, June 10, 1904, apparently well. Capacity of the bladder was 120 cubic centimetres. She was advised to return in six weeks in order to have her bladder dilated.

In studying these four operations on the lower end of the ureter, by the extraperitoneal route, under a local anæsthetic, one not only has an opportunity to learn something about the advisability of the use of a local anæsthetic in these cases and the advantages of the extraperitoneal route, but, what seems to me to be of the greatest importance, a knowledge is obtained of the factors causing pain in these operations. A knowledge of the distribution of the sensation of pain in any part of the body is not only of assistance in choosing an anæsthetic for operations in that portion of the body, but may eventually help us in the interpretation of the symptoms arising from diseased conditions of these parts.

THE CAUSATION OF PAIN IN THESE OPERATIONS.—In all four operations, closing the skin incision was the most painful step in the operation, and anything causing traction on the parietal peritoneum, as has been emphasized by Lennander,[10]

was painful, as, freeing the peritoneum from the abdominal walls and sides of the pelvis, traction on the ureter, and freeing it from its peritoneal attachments. In order to expose the field of operation, it is necessary to maintain pressure on the freed peritoneum, and this is painful unless it is done carefully, and any change in position must be accomplished slowly.

Apparently the ureter (freed from its peritoneal attachments) may be pinched, incised, and sutured without causing pain. Is there any sensation of pain in the ureter, or is any pain which may be referred to it due to the stretching of nerves in the parietal peritoneum covering the pelvic portion of the ureter? The passage of a ureteral calculus is supposed to cause ureteral pain. One may inject the ureter with fluid through a ureteral catheter and pain will be felt in the region of the kidney, this being a very efficient means of locating obscure pain in the side, as has been described by Kelly.[11] We realize, too, that the palpation of a diseased ureter may be painful. The histories of cases of intentional or accidental ligation of the ureters help us but very little. We have discovered that a ureter has been accidentally occluded by ligatures in three gynæcological cases in this hospital which have come to autopsy, and yet there were no symptoms referable to the injury, or such as might have been present were obscured by other symptoms resulting from the operation. Two of these three cases have been reported.[12] Noble[13] refers to a similar experience, and the cases reported by Veit,[14] Bastianelli,[15] and Phaenemenow,[16] where a ureter was intentionally ligated, the patient recovered without any symptoms referable to the injury; while in a case reported by Futh[17] and also one by Landau,[18] the symptoms were those of a sense of fulness or dull pain in the region of the kidney. I saw, in consultation, a patient in whom both ureters had been cut off and ligated for thirty-six hours, and yet anuria was the *only* symptom present, and both ureters, which were greatly distended, were released and reimplanted in the bladder, and the patient recovered. Bailey[6] has reported an instance of the ligation of both ureters and their release after forty-eight hours,

with recovery, and anuria was the only symptom. In Purcell's [8] case of ligation of both ureters, with subsequent release at the end of fifty-eight hours and recovery, there were not any localizing symptoms until the third day. Markoe and Wood [4] report a case of accidental ligation of both ureters of twenty-four hours' duration, and yet there were no symptoms distinctly referable to the injury. In the repair of a vesicovaginal fistula in this hospital a ureter was apparently included in a ligature. Pain in course of ureter for four days, with chills and fever, which disappeared on releasing some of the suture. And in another instance (Gyn. No. 11,164) where a vesicovaginal fistula was made, in order to relieve a cystitis, and the mucosa of the bladder was sutured to that of the vagina, apparently one of the sutures occluded or compressed the ureteral orifice, for there was pain and tenderness in the region of the left kidney, which was relieved by releasing the suture. In these last two cases one could not tell whether one was dealing with partial or complete occlusion of the ureter. It is possible that the ureter may be completely occluded and the patient's convalescence be uninterrupted and entirely without any symptoms referable to the injury. Stoeckel [19] has referred to the above, and states that in the absence of infection there are often apparently no definite symptoms, or such as there are may be easily obscured by the symptoms following such an operation; and the other kidney, if sound, can readily adjust itself to the additional work, and so prevent the threatened uræmia.

Effect of the Operations on the Patient.—By studying the pulse-rate during the operation, it may be seen that it increases in rate during the active operative manipulations and drops as soon as these stop. If frequent rests are taken, the pulse-curve becomes very irregular (Charts III, V, and VI), while, if the rests are less frequent, a higher and more even pulse-rate is maintained throughout the operation (Chart II). Several factors influence this pulse-rate, as, hard work, for it is equivalent to hard muscular exercise (the patients like to brace their feet against something or grasp something firmly with their hands); the excitement and mental

strain must also influence the rate, and possibly the pain also increases the pulse-rate. The result of the above is that the patient becomes fatigued, and the only apparent effect of these operations, lasting from four hours and thirty minutes to six hours and ten minutes, was that of fatigue, just as one might feel after spending several hours in the dentist's chair. The patients stood the operations very well, and all stated that they preferred local to a general anæsthetic.

UPON WHAT DOES THE SUCCESS OF THESE OPERATIONS DEPEND?—1. In knowing what does and what does not hurt, and thus avoiding all unnecessary pain. Severe pain will unfit the patient for any further progress of the operation, unless a general anæsthetic is used.

2. In going very gradually and carefully and avoiding any sudden moves, which is especially true in exposing the field of operation.

3. In stopping frequently in order to let the patient rest and change her position.

4. In choosing suitable patients, and letting them know just what to expect, so that they may help you in the determination of what hurts, in order that unnecessary pain may be avoided.

5. In the presence of a so-called "moral anæsthetist," who will encourage the patient and divert her attention when necessary.

6. The use of morphia before and during the operation probably helps in some cases. A towel over the eyes of the patient, so she cannot see what is going on, and cotton in the ears to muffle any sounds from the use of instruments also helps.

I was tempted to try a local anæsthetic in the first case on account of the contraindications of a general anæsthetic, for it seemed that an operation would have to be done under a local anæsthetic or further operative attempts abandoned. The satisfactory use of local anæsthesia in the radical cure of certain cases of hernia, as reported by Cushing,[20] seemed to me to offer inducements for its use in the surgery of the lower ends of the

ureters by the inguinal extraperitoneal route. The satisfactory result of the first operation on the first case induced me to try it in the next three operations, and all three cases having had operations under both a local and a general anæsthetic, while admitting that the operation under local anæsthesia at times was painful and very fatiguing, prefer local to general anæsthesia.

The solution of cocaine used was:

Cocainæ hydrochloratis	0.1	gramme
Morphinæ hydrochloratis	0.02	gramme
Sodii chloridi	0.2	gramme
Aquæ destillata ad	100	cubic centimetres

About thirty cubic centimetres of this solution are placed in a small flask and sterilized with the dressings in a steam sterilizer.

THE CHOICE OF AN INCISION, AND THE INGUINAL EXTRAPERITONEAL ROUTE AS AN AVENUE FOR EXPOSING THE LOWER END OF THE URETER.—By the inguinal extraperitoneal route, one refers to an abdominal incision down to the peritoneum, and then the peritoneum is pushed away from the abdominal and pelvic walls, and thus the field of operation, in which the lower end of the ureter lies, is exposed. Various incisions have been employed for this route.

Twynam,[21] in 1890, employed this route for the successful removal of a ureteral calculus, situated two inches above the bladder, in a boy eight years old. His incision was similar to one used for the ligation of the common iliac artery. Since Twynam's case, this route has been used by others for the removal of calculi in the lower end of the ureter. See table of cases compiled by Schenck.[22]

Rouffart,[23] in 1895, suggested making an incision along the outer border of the rectus, dissecting the peritoneum from the pelvic wall, and thus exposing the lower end of the ureter, for the resection of the ureter and its implantation in the bladder for the cure of ureterovaginal fistulæ.

In 1898, Kelly[24] employed the extraperitoneal route for

the cure of an ureterovaginal fistula. The incision was fifteen centimetres long, and began two centimetres inside of the right anterior superior iliac spine and ended near the pubic spine. Somewhat similar incisions were employed in operations in Cases I, II, and III.

The following year Israel[25] reported a similar but more extensive incision for the successful resection of an ureteral stricture and implantation of the ureter into the bladder.

Mackenrodt,[26] in 1899, reported a ureterovesical implantation by the extraperitoneal route, using an incision along the outer border of the rectus muscle, as suggested by Rouffart.

Crossed, curved abdominal incisions have been made by Wertheim[27] and others.

Smith,[28] in 1901, used an incision in the median line for the same purpose.

One sees that almost as many incisions have been used for this route as there are possibilities, and it seems almost useless to add others. Nevertheless, it seems to me that an intramuscular incision, in which the muscle fibres are not cut, offers advantages over the above, in that there is less injury, and also less danger of a postoperative hernia; for I believe in the extensive draining of the field of operation. One incision which I have found very useful for exposing the lower end of the ureter is a so-called "gridiron incision," made similar to the well-known McBurney incision, down to the peritoneum, except that it should be made a little lower down. Such an incision was used in Case I. Another serviceable incision is a longitudinal one through the rectus muscle. I have tried all the various incisions above referred to except the transverse abdominal incisions, and I think that the two intramuscular incisions referred to, in which the muscle fibres are separated but not cut, are to be preferred to the others, and by either of these incisions the ureter can usually be exposed from the pelvic brim to the bladder, and if more room is desired, the muscles may be cut at any time.

CONCLUSIONS.

I. In favor of the use of a general anæsthetic it may be said:

1. The patient is unconscious of everything associated with the operation, including the pain.

2. There is complete relaxation, thus permitting a better exposure of the field of operation, which is especially desirable in operations in the pelvis.

3. The operation takes a much shorter time than a similar operation under a local anæsthetic.

4. The operation is easier, and all the above render it possible usually to do better work than under a local anæsthetic.

II. There are many disadvantages in the use of a general anæsthetic.

1. In certain cases it is contraindicated.

2. A small percentage of the cases die on the table from the anæsthetic alone.

3. In all cases it lowers the general resistance of the individual, thus predisposing the patient to many postoperative complications.

4. The taking of the anæsthetic is usually very unpleasant, and the recovery from it still more so.

III. If certain operations do not cause any pain and very little discomfort, why should patients be subjected to the dangers and discomforts of a general anæsthetic in these operations? And if certain steps in a long operation, where a general anæsthetic is contraindicated, are painless, why not use a temporary general anæsthetic, such as nitrous oxide, or a local anæsthetic, as cocaine, *only* for that part of the operation which causes pain?

IV. A knowledge of the distribution of the sensation of pain in the various parts of the body is not only interesting from a physiological stand-point, but especially valuable in the diagnosis of diseased conditions, and the ***intelligent*** use of a local or temporary anæsthetic in those cases in which a general anæsthetic is contraindicated.

V. Pathological conditions of the lower ends of the ure-

ters usually impair the function of the ureters, either interfering with the passage of urine from the kidneys to the bladder or permitting a reflux of urine from the bladder into the kidneys. In either instance the result is interference with the function of the kidneys and a condition of actual or unstable renal sufficiency results, thus lowering the general resistance of the individual, and in addition predisposing the kidneys to infection. The result of the above is that such individuals may not be well suited to a long operation under a general anæsthetic, which may be necessary to cure the local condition.

VI. In four operations on the lower ends of the ureters by the inguinal extraperitoneal route under local anæsthesia, lasting from four hours and thirty minutes to six hours and ten minutes, the only apparent effect of the operation, aside from postural discomfort and at times some pain (endurable), was that of fatigue, as of a similar length of time spent in a dentist's chair.

VII. The success of these operations is dependent on a knowledge of what does and what does not hurt, and on proceeding slowly and carefully, remembering that *anything causing traction* on the *parietal peritoneum* is *painful.* Pinching, cutting, and suturing the ureter in these cases apparently did not cause any pain, and similar treatment of the bladder in one case was painless but painful in another (bladder much thickened; chronic cystitis). Closing the abdominal incision was the most painful step in all four operations.

VIII. The extraperitoneal route is a very satisfactory way of reaching the lower ends of the ureters, and would be less painful than the intraperitoneal, and has many advantages over the other. The danger from infection is less; by draining freely, the retroperitoneal tissue is well protected and the intestines are kept back by the peritoneum, thus giving one a good exposure; and there must be less shock associated with the extraperitoneal than with the intraperitoneal operation.

IX. Many incisions through the abdominal wall have been used for the extraperitoneal route, and the intramuscular incisions can be recommended, as doing little harm, rendering the

liability of postoperative hernia small, and affording a good exposure. *Two incisions are very good; first, a "gridiron incision" lateral to the rectus similar to the well-known McBurney, only a little lower; and, secondly, a longitudinal incision through the rectus muscle.* Through either incision the ureter can usually be exposed from the pelvic brim to the bladder, and if more room is desired, the muscles may be cut at any time.

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